IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Alexander Steinberg, Zinovy Livshits, Itshak Wilf, Moshe Nissim, Michael Tamir, Avi Sharir and David Aufhauser

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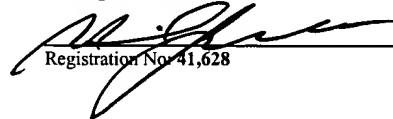
Filed: **Herewith**   Examiner: **Not yet assigned**

For: **METHOD AND APPARATUS FOR DETERMINING THE POSITION OF A TV CAMERA FOR USE IN A VIRTUAL STUDIO**

I, **Michael J. Bonella**, Registration No. **41,628** certify that this correspondence is being deposited with the U.S. Postal Service as First Class mail in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

On August 2, 2001

Registration No. 41,628

Assistant Commissioner
for Patents
Washington, D.C. 20231

Dear Sir:

PRELIMINARY AMENDMENT

Please add claims 25-42, and cancel claim 1. Support for the new claims can be found at

inter alia pages 4-14 and Figures 1-10.

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25.   A method of determining a position of a TV camera relative to a patterned panel,

comprising:

identifying a plurality of edge points of the patterned panel from a video signal produced by the camera;

determining a perspective of the patterned panel relative to the camera from the plurality of edge points with a slope and intercept process; and

determining a relative position of the camera relative to the patterned panel by reference to the calculated perspective of the patterned panel.

26.   The method of claim 25, wherein identifying further comprises identifying the plurality of first edge points and a plurality of second edge points and wherein determining the perspective further comprises producing an edge image form the plurality of first edge points and the plurality of second edge points.

27.   The method of claim 25, wherein the patterned panel comprises a pattern of vertical and horizontal lines that delineate a color difference and wherein each identified edge point is disposed on one of said horizontal and vertical lines.

28.   The method of claim 27, wherein determining the perspective further comprises analyzing all identified edge points and grouping at least some of the identified edge points into a first group that corresponds to the horizontal lines and a second group that corresponds to the

vertical lines.

29.   The method of claim 28, wherein determining the perspective further comprises

allocating the edge points in the first group and the second group to specific horizontal and

vertical lines.

30.   The method of claim 29, wherein determining the perspective further comprises

computing vanishing points of the horizontal and vertical lines after allocating the edge points,

the vanishing points being computed with a defined location error.

31.   The method of claim 30, wherein determining the perspective further comprises

projecting the edge points, that were allocated to specific horizontal lines, from the computed

vanishing point of the horizontal lines to obtain an edge projection profile map comprising peaks

and troughs.

32.   The method of claim 31, wherein determining the perspective further comprises

assigning each edge point that was allocated to a specific horizontal line to a most probable peak

of the edge projection profile map and for a given most probable peak producing a list of lines

from a plurality of candidate lines that may be indicated by the given most probable peak.

33.   The method of claim 32, wherein determining the perspective further comprises specifying a line from the patterned panel for each list of lines or discarding each list of lines that does not correspond to a line of the patterned panel.

34.   The method of claim 30, wherein determining the perspective further comprises

projecting the edge points that were allocated to specific vertical lines from the computed vanishing points of the vertical lines to obtain an edge projection profile map comprising peaks and troughs;

assigning each edge point that was allocated to a specific vertical line to a most probable peak and for a given most probable peak producing a list of lines from a plurality of candidate lines that may be indicated by the given most probable peak; and

for each list of lines either specifying a line from the patterned panel that is indicative of the respective list of lines or discarding each list of lines that does not correspond to a line of the patterned panel.

35.   The method of claim 30, wherein computing vanishing points comprises computing accurate vanishing points.

36.   The method of claim 35, wherein determining the perspective further comprises determining a shift and scale of the patterned panel from the accurate vanishing points.

37.   The method of claim 36, wherein determining the shift and scale comprises

producing an accurate line pattern by means of inverse perspective transformation and comparing

the patterned panel with the accurate line pattern.

38.   The method of claim 36, wherein comparing the patterned panel with the accurate

line pattern comprises:

        identifying a first horizontal line in the accurate line pattern;

        identifying a second horizontal line in the accurate line pattern;

        calculating a distance between the first and the second horizontal lines;

        comparing the calculated distance between the first and the second horizontal

lines with the known patterned panel to produce a horizontal position and scale determination;

        identifying a first vertical line in the accurate line pattern;

        identifying a second vertical line in the accurate line pattern;

        calculating a distance between the first and the second vertical lines;

        comparing the calculated distance between the first and the second vertical lines

with the known patterned panel to produce a vertical position and scale determination; and

        wherein determining the relative position comprises determining from said

horizontal and vertical position scale determinations the position of the TV camera relative to the

patterned panel.

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39.   A system for determining a position of a TV camera relative to a patterned panel

being viewed by the TV camera, comprising:

        means for identifying a plurality of edge points of the patterned panel from video

signal produced by said camera;

        means for processing the edge points to calculate a perspective of the pattern

relative to the camera; the means for processing comprising means for clustering the plurality of

edge points and to specific lines using a slope and intercept process; and

        means for determining a relative position of the camera relative to the patterned

panel by reference to the perspective of the pattern.

40.   The system of claim 39, wherein the pattern panel is a chroma-key panel.

41.   The system of claim 39, wherein the pattern panel comprises two or more distance

coded families of lines.

42.   The system of claim 39, wherein the pattern panel comprises two or more distance

coded families of lines such that the lines of each family intersect at a common point.

        Attached hereto is a marked-up version of the changes made to the specification
and claims by the current amendment. The attached page is captioned **"Version with markings
to show changes made."**

Respectfully submitted,

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Date: August 2, 2001

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claim 1 has been canceled.

Claims 25 through 42 have been added.